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Acephate reduces populations of needlemining larch casebearer in laboratory

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1980. *Acephate reduces populations of needlemining larch casebearer in laboratory.* Res. Note PSW-344, 2 p. Pacific Southwest Forest and Range Exp. Stn., Forest Serv., U.S. Dep. Agric., Berkeley, Calif.

Acephate was effective in reducing populations of needlemining larch casebearer (*Coleophora laricella* [Hbn.]) in potted larch (*Larix occidentalis* Nutt.) seedlings in the laboratory. A dose range of 9 to 11 g/ha resulted in 50 percent mortality, and one of 34 to 43 g/ha in 90 percent mortality. Because specific densities of needlemining larvae in live larch seedlings were necessary to increase the precision of the observations, rearing procedures were developed to infest groups of seedlings. The optimum density and distribution of eggs were obtained with small (25 by 30 by 41 cm) cages, screened on three sides and the top, and holding 2 to 4 trees, infested for 3 to 5 days with 10 to 75 adult moths collected without regard to sex.

Retrieval Terms: acephate, systemic insecticides, larch casebearer, *Coleophora laricella*, laboratory rearing, insecticide tests

The larch casebearer (*Coleophora laricella* [Hbn.]) is a major defoliator of western larch (*Larix occidentalis* Nutt.) in North America. Current control programs focus on the programmed release of introduced parasitoids.[1] Under certain conditions, however, temporary measures using insecticides may be warranted.[2] Earlier studies have concentrated on larvae that were exposed to insecticide deposits as the insects fed on needle surfaces in spring. Recent laboratory results have suggested that earlier instars were more susceptible to contact insecticides, such as malathion, dimethoate, and mexacarbate sprays.[3] The results encouraged us to design an experiment to evaluate the effects of acephate, a systemic insecticide that is transported through plant tissues. A systemic compound was tested because contact insecticides usually cannot reach insects that are within the needles of trees.

This note reports techniques used to rear larch casebearers in potted larch seedlings, and laboratory tests of acephate sprayed on larch casebearers in the first and second instars.[4] Such tests are a necessary first step in developing alternative control strategy using chemicals.

REARING TECHNIQUES

To evaluate the penetration toxicity of acephate in live host needles, it was necessary to develop a technique to provide approximately 100 larvae per seedling which we assumed would increase the precision of our analysis. This technique would give us a total sample of about 3,000 insects. Although Ryan[5] developed procedures for year-round laboratory rearing of larch casebearer for the propagation of its parasites, laboratory procedures for infesting more than one seedling per cage were not available.

Adults were collected from larch infested with over-wintering larvae and pupae. Larch seedlings were grown in a greenhouse with a 14-hour photoperiod and temperatures of 24°C (20 to 27°C) daytime and 16°C nighttime. Seedlings were from 10 to 30 cm high, with most about 20 cm.

Glass lamp chimneys (fitted with screen tops), and three different sizes of screened cage (91 cm cube, 41 by 41 by 91 cm and 25 by 30 by 41 cm) were tried with various numbers of trees and adults.

SPRAY TECHNIQUES

Infested seedlings were shipped in lots of 12 to Berkeley, California, from Moscow, Idaho, for bioassays. Each shipment of 12 trees was divided into 2 sets of 6 trees and doses of acephate applied at random to the trees within each set. Trees were sprayed in a stainless steel spray chamber[6] equipped with a fine-spray nozzle fitted to an orifice in the top of the chamber. Each infested larch seedling was exposed to acephate spray for 1 minute. Control trees were sprayed with water only.

To establish dose-mortality regression curves, we sprayed five insecti-

cide dilutions of increasing concentration at a constant delivery volume (0.3 ml in spray reservoir) and replicated each concentration eight times. Deposits were estimated by spraying 9-cm filter paper at mid-crown height with insecticide dilutions containing 1.0 percent aniline blue dye. The dye concentrations were measured colorimetrically and converted to insecticide concentrations by reading from a standard curve,[7] then converted to ounces per acre and grams per hectare.

RESULTS AND DISCUSSION

The techniques used to induce mating and oviposition produced 72 suitable egg-infested seedlings. The average number and range of eggs per seedling, by shipment, were as follows: 76 (41-139), 72 (44-120), 68 (50-155), 124 (42-177), 288 (168-722), 135 (124-159).

The best density and distribution of eggs were obtained with the small cages (25 by 30 by 41 cm), screened on three sides and the top, and holding 2 to 4 trees, infested for 3 to 5 days with 10 to 75 adult moths (collected without regard to sex). These cages restricted the lighting in the back; consequently, more oviposition occurred on the seedlings in the front of the cages. Ten adults usually produced 10 eggs in 5 days on the 2 trees receiving the most light and about 5 eggs on the trees in the back of the cage. Introducing more adults (to a maximum of 75) resulted in more eggs on all seedlings, but also overstocked the seedlings that received the most light with 400 or more eggs in 2 or 3 days. A preferred method would be to use 2 seedlings per cage and release 30 adults without regard to sex.

To determine the efficacy of acephate, we examined 3164 needlemining larvae on 60 potted trees. A minimum of 50 mined needles were moved at random from each tree to estimate mortality at 7 days. Infested needles were candled on a microscope stage with substage illumination and probed to determine larval death.

The results were transformed to probit mortality and logarithmic dose to compute LD_{50} and LD_{90} by the POLO computer program (*table 1*).[8] A dose range of 9 to 11 g/ha resulted in 50 percent mortality; a dose range of 34 to 43 g/ha reduced the laboratory population by 90 percent. These results and those by Hard and Washburn[9,10] indicate that acephate is effective against needlemining casebearer. Acephate's effectiveness in both laboratory and field studies can be attributed, in part, to its ability to penetrate plant cuticle and epidermis and to distribute itself in the chlorenchyma.[11] These conclusions are consistent with results obtained in a study of the penetration, translocation and degradation of dimethoate, an organophosphate with systemic properties similar to acephate, when applied to foliage.[12,13]

Table 1—*Mortality of needlemining larch casebearers infesting 1-year-old potted western larch seedlings sprayed with acephate in the laboratory*

Dose (g/ha)[1]	Total larvae	Mortality at 7 days (percent)[2,3]
0	430	23.7
4	528	36.9
8	535	40.7
20	556	25.9
40	569	90.1
80	546	97.6

[1] Each dose replicated eight times.

[2] LD_{50} and LD_{90} with 95 percent confidence limits were 10.1 (8.9-11.3) and 38.1 (34.3-42.8).

[3] Slope ± SE : 2.22 ± 0.11.

NOTES

[1] Denton, Robert E. 1972. *Establishment of* Agathis pumila *(Ratz.) for control of larch casebearer, and notes on native parasitism and predation in Idaho.* USDA Forest Serv. Res. Note INT-64, 6 p. Intermountain Forest and Range Exp. Stn., Ogden, Utah.

[2] Ryan, R. B., W. E. Bousefield, R. E. Denton, R. L. Johnsey, L. F. Pettinger, and R. F. Schmitz. 1975. *Additional releases of larch casebearer parasites for biological control in the Western United States.* USDA Forest Serv. Res. Note PNW-242, 7 p. Pacific Northwest Forest and Range Exp. Stn., Portland, Oreg.

[3] Denton, Robert E., and Scott Tunnock. 1968. *Low-volume application of malathion by helicopter for controlling larch casebearer.* J. Econ. Entomol. 61:582-583.

[4] This paper describes research involving insecticides. It does not make recommendations for their use, nor does it imply that any uses described have been registered. All use of insecticides must be registered by the appropriate State and/or Federal Agencies before they can be recommended.

[5] Ryan, R. B. 1979. *The larch casebearer (Lepidoptera:Coleophoridae) and its parasites. I. Maintaining year-round availability of larch foliage and the casebearer for parasite rearing.* Can. Entomol. 111:471-476.

[6] Robertson, Jacqueline L., Robert L. Lyon, Theresa L. Andrews, Emanuel E. Moellman, and Marion Page. 1979. *Moellman spray chamber: versatile research tool for laboratory bioassays.* Res. Note PSW-335, 6 p., illus. Pacific Southwest Forest and Range Exp. Stn., Forest Serv., U.S. Dep. Agric., Berkeley, Calif.

[7] Rayner, A. C. 1956. *Colorimetric estimation of dyed insecticide spray deposit using a paper sampling surface.* Can. Entomol. 88(6):394.

[8] Russell, Robert M., Jacqueline L. Robertson, and N. E. Savin. 1977. *POLO: a new computer program for probit analysis.* Bull. Entomol. Soc. Amer. 23(3):209-213.

[9] Hard, John S., Stanley Meso, and Michael Haskett. 1977. *Larch casebearer control on western larch, 1976.* Insectic. and Acaricide Tests 2:153.

[10] Washburn, Richard I., R. Ladd Livingston, and George P. Markin. 1977. *An aerial test of Orthene against the larch casebearer.* USDA Forest Serv. Res. Note INT-226, 6 p. Intermountain Forest and Range Exp. Stn., Ogden, Utah.

[11] Crisp, C. E., T. W. Koerber, C. E. Richmond, and B. H. Roettgering. 1979. *Acropetal translocation of acephate into terminal shoots of Jeffrey pine for the chemical control of western pine shoot borer.* In *Proceedings of the symposium on systemic chemical treatments in tree culture* [Oct. 9-11, 1978, East Lansing, Mich.], p. 307-324.

[12] Pietri-Tonelli, P. de. 1965. *Penetration and translocation of Rogor applied to plants.* Advan. Pest Control Res. 6:31-84.

[13] Lucier, G. W., and R. E. Menzer. 1968. *Metabolism of dimethoate in bean plants in relation to its mode of application.* J. Agric. Food Chem. 16:936-45.

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